

```

1  import numpy as np
2  import matplotlib.pyplot as plt
3  import useful as use
4  import pdb
5  np.set_printoptions(threshold=np.inf)
6
7
8  fig1, ax3 = plt.subplots()
9  #####
10 #initial conditions
11
12 dt = [.4, .2, .1]
13
14 #####
15 #Fourth-Order Forest Ruth
16
17
18 for j in range(len(dt)):
19     →r_0 = [1, 0, 0]
20     →v_0 = [0, .5, 0]
21     →t = 0
22     →r = r_0
23     →v = v_0
24     →s = 2**(1/3)
25     →H = dt[j]/(2-s)
26
27     →for i in range(0, int((6*np.pi)/dt[j])):
28         →→v_n = np.asarray(v[len(v)-1])
29         →→r_n = np.asarray(r[len(r)-1])
30
31         →→#####
32         →→r_n = use.int_q_array(r_n, v_n, .5*H)
33         →→B = np.asarray([0, 0, 1/r_n[0]**2])
34         →→v_n = use.v_magnetic_calc(r_n, v_n, B, H)
35         →→r_n = use.int_q_array(r_n, v_n, .5*H)
36         →→#####
37         →→r_n = use.int_q_array(r_n, v_n, -.5*s*H)
38         →→B = np.asarray([0, 0, 1/r_n[0]**2])
39         →→v_n = use.v_magnetic_calc(r_n, v_n, B, -s*H)
40         →→r_n = use.int_q_array(r_n, v_n, -.5*s*H)
41         →→#####
42         →→r_n = use.int_q_array(r_n, v_n, .5*H)
43         →→B = np.asarray([0, 0, 1/r_n[0]**2])
44         →→v_n = use.v_magnetic_calc(r_n, v_n, B, H)
45         →→r_n = use.int_q_array(r_n, v_n, .5*H)
46         →→#####
47         →→r.append(r_n)
48         →→v.append(v_n)
49
50     →r = np.asarray(r)
51     →x_val = [x[0] for x in r]
52     →y_val = [x[1] for x in r]
53     →ax3.plot(x_val, y_val)
54
55
56 #####
57 #####
58 #graphing
59 ax3.set_ylabel('Y Coordinate')
60 ax3.set_xlabel('X Coordinate')
61 ax3.legend(('dt = .4', 'dt = .2', 'dt = .1'), loc='upper right')
62 ax3.set_title("Particle Trajectory - T4 Algorithm", va='bottom')
63 plt.show()

```